



Internal Combustion Engines

Lecture-1

Introduction

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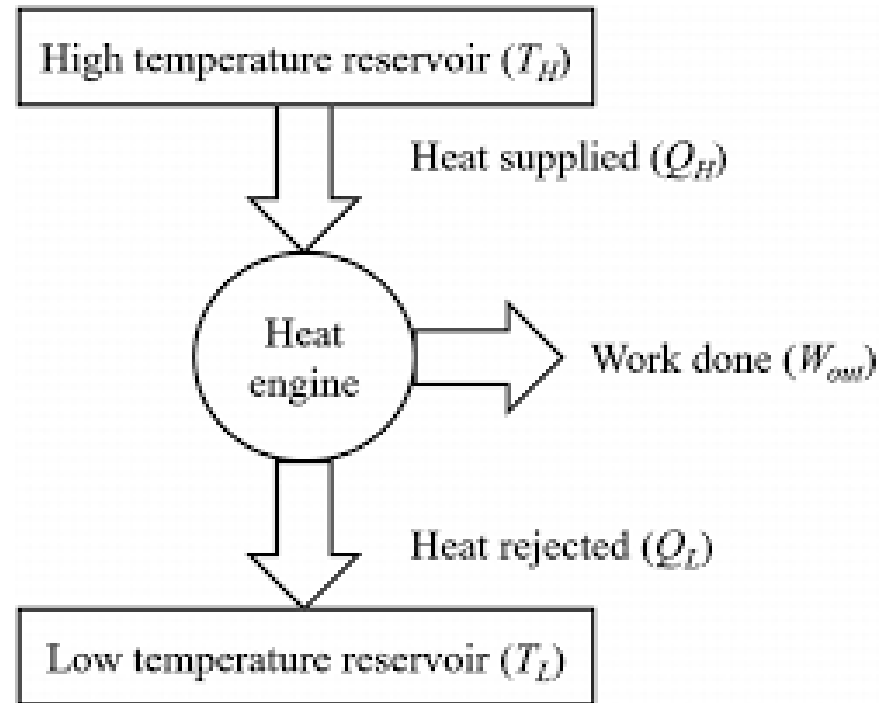


What is Engine?

Kelvin Planck Statement:

It is impossible to construct a cyclic device that produces work interacting with a single reservoir

Engine (Heat Engine) is a cyclic device that produces work. It receives heat from a high temperature reservoir and rejects heat to a low temperature reservoir.

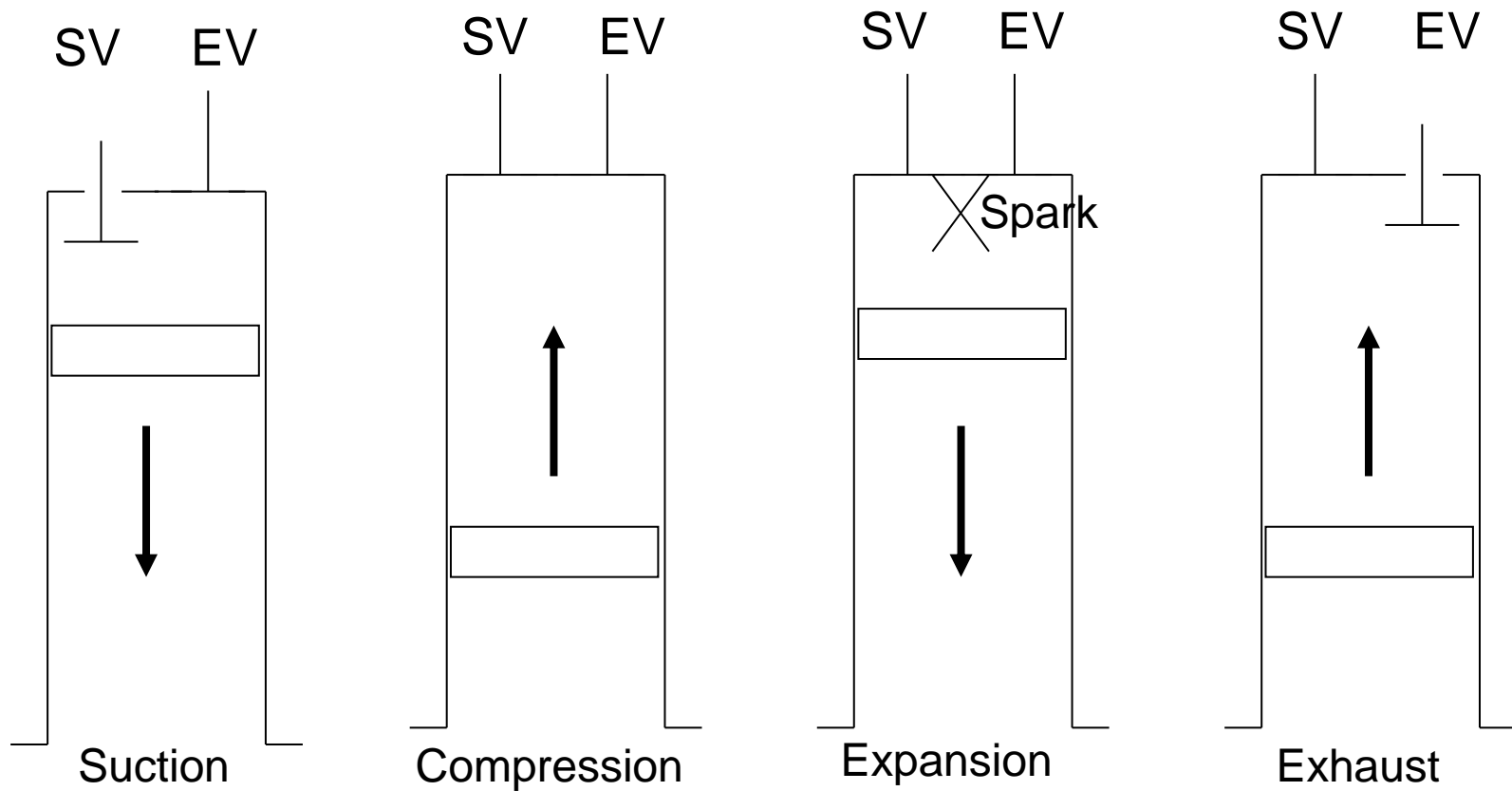




Internal Combustion Engine

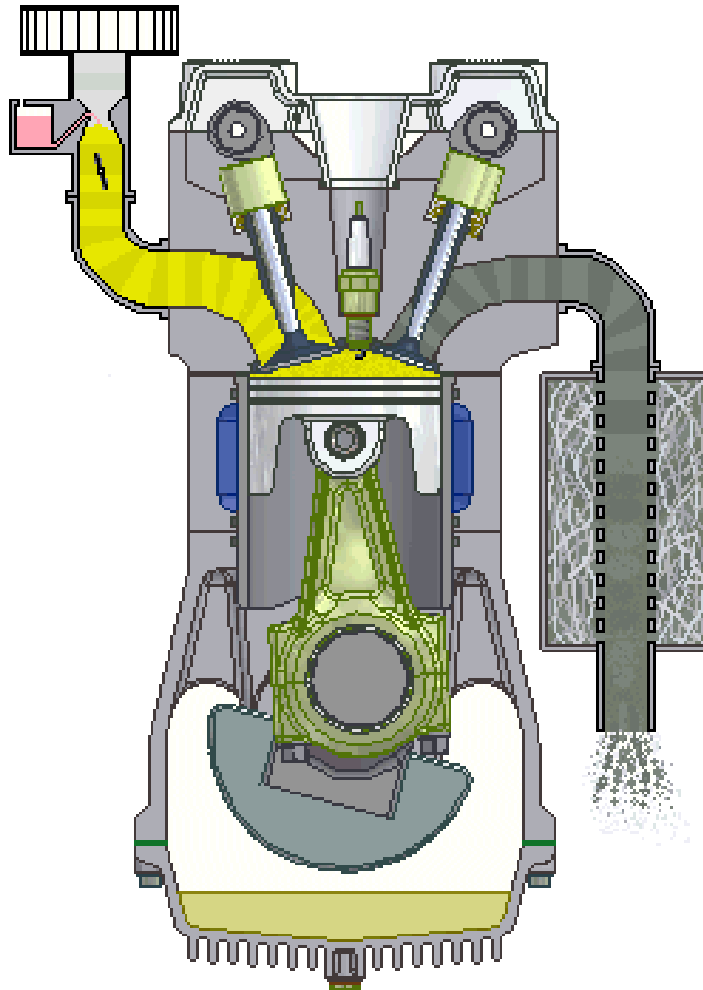
- An **external combustion engine** (EC engine) is a heat **engine** where a working fluid, contained internally, is heated by **combustion** in an **external** source, through the **engine** wall or a heat exchanger. The fluid then, by expanding and acting on the mechanism of the **engine**, produces motion and usable work. Example: thermal power plant
- An **internal combustion engine** (ICE) is a heat engine in which the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit.
- Usually we refer reciprocation piston engines with intermittent combustion as IC Engine, like spark ignition engine, compression ignition engine. We shall focus our study of this course towards this type.
- There is another type of internal combustion engines that use continuous firing, like gas turbine, rocket engine.

Four Stroke SI Engine



SV: Suction Valve; EV: Exhaust Valve

4-Stroke SI Engine Working



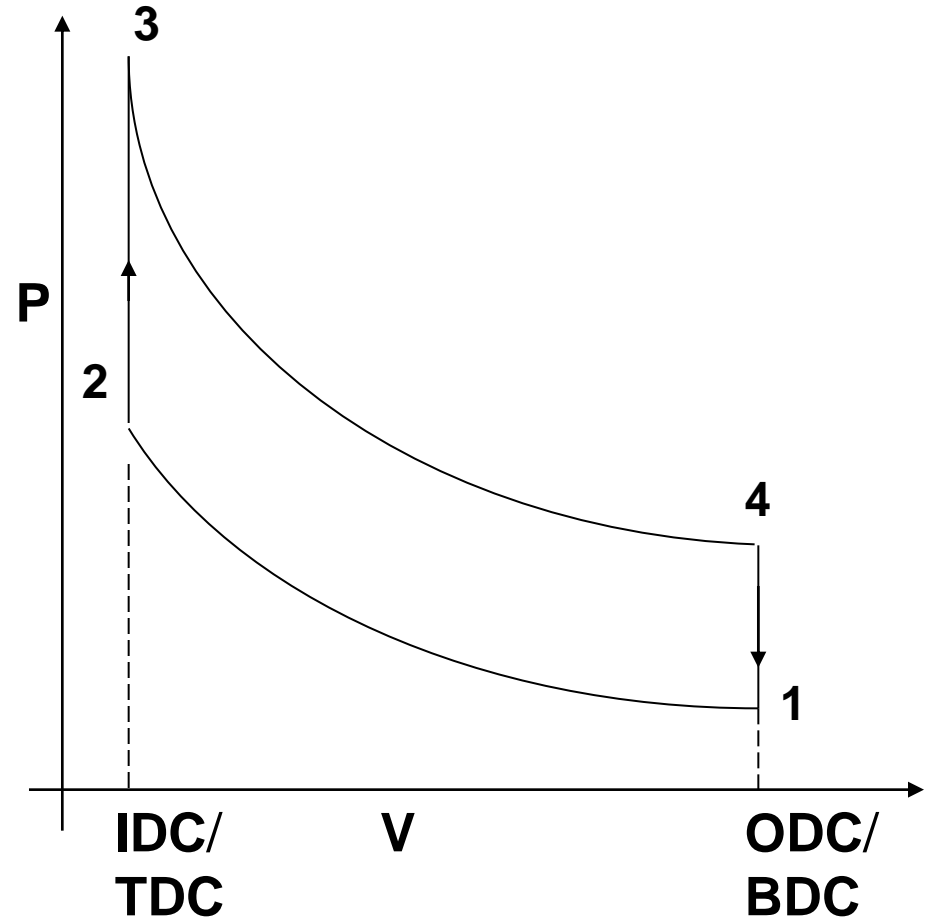
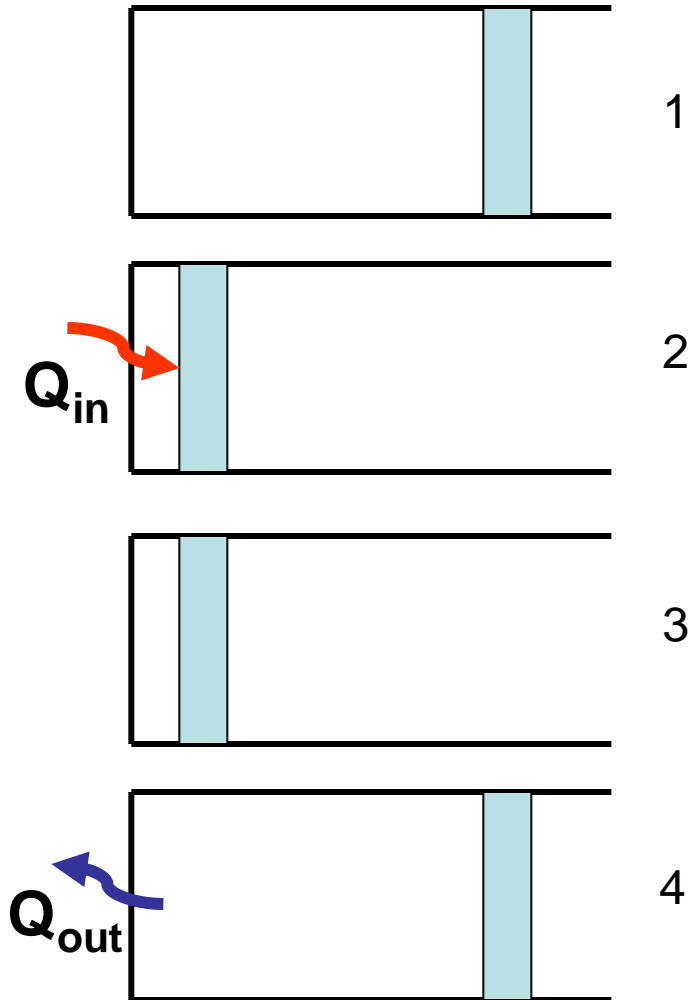
Components:

- Air Filter
- Carburetor
- Suction Manifold
- Suction Valve
- Cylinder
- Piston
- Connecting Rod
- Crank
- Crank Shaft
- Crank Case
- Cylinder block
- Engine head
- Spark plug
- Exhaust valve
- Exhaust Manifold
- Catalytic Converter
- Suction/Exhaust Cam
- Cooling Jacket

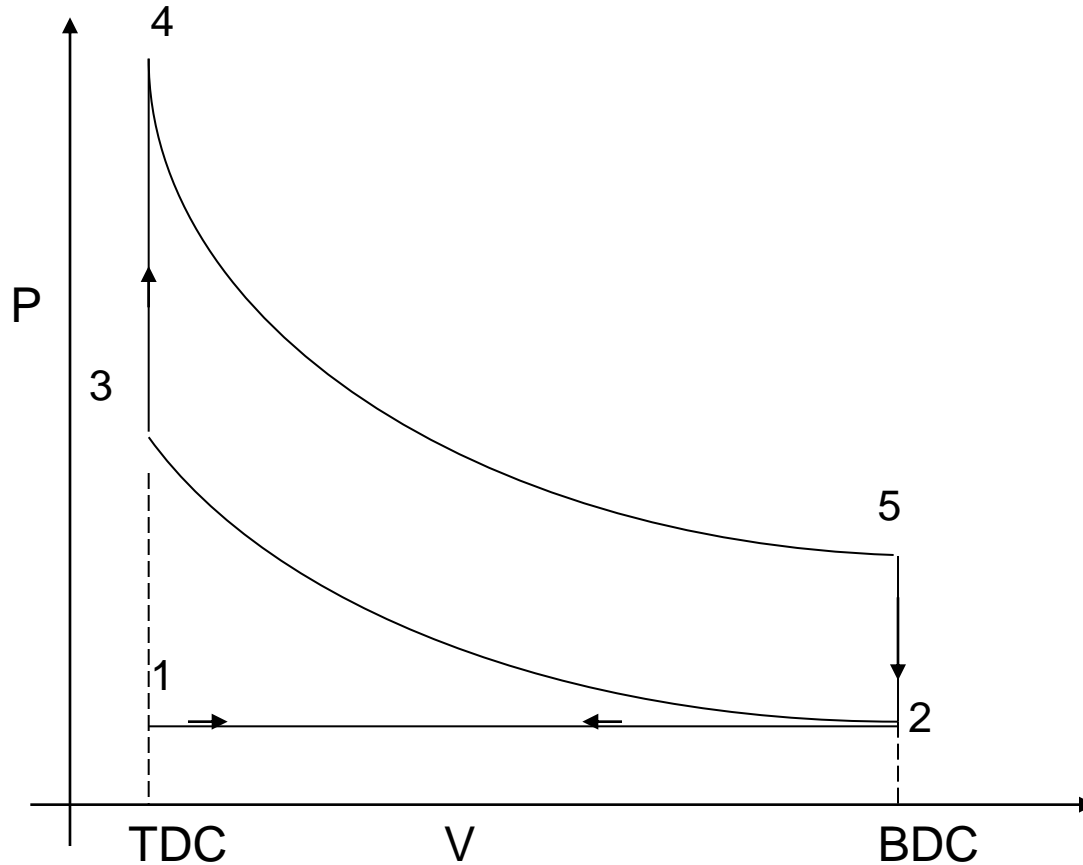
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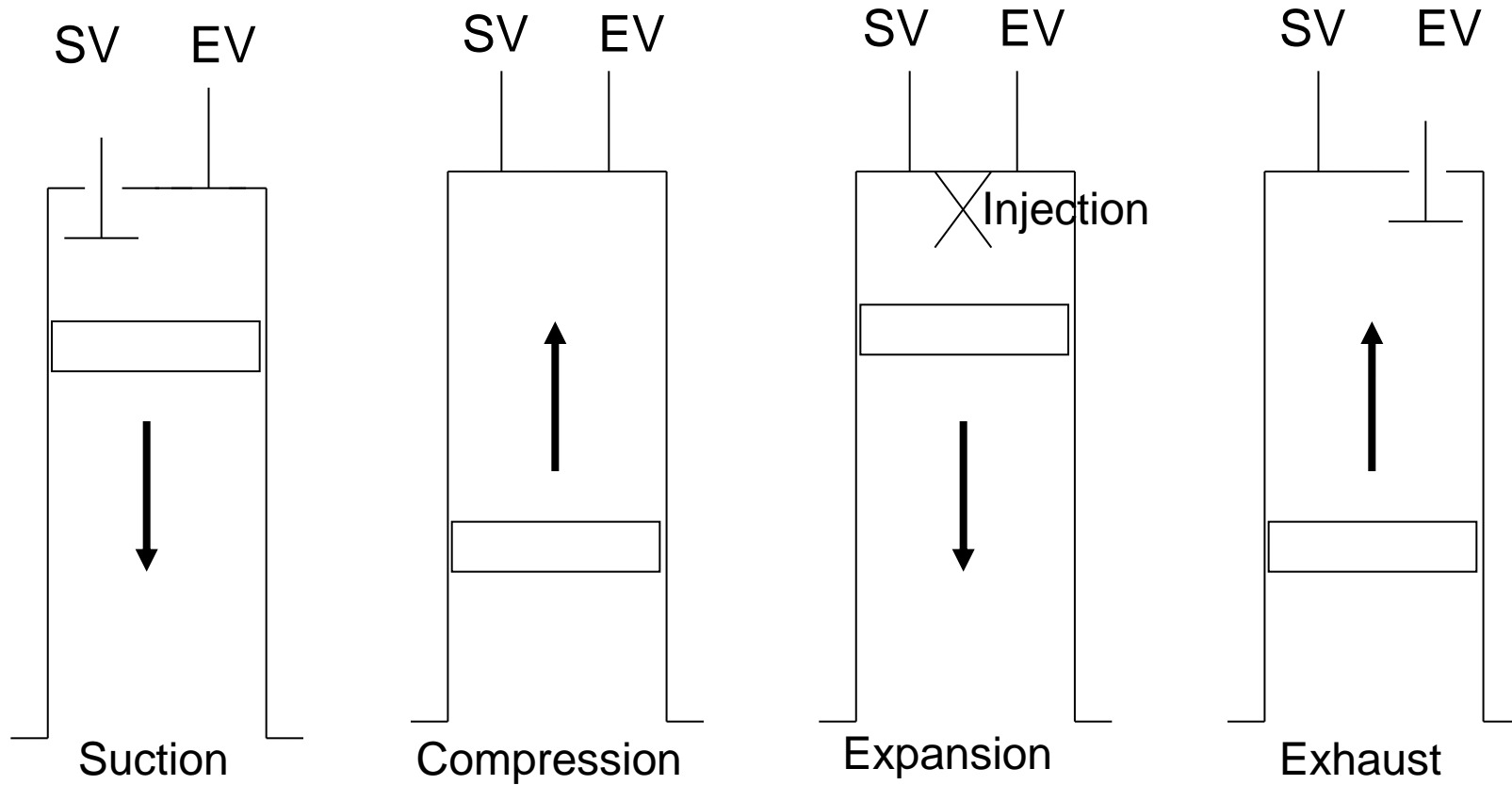
Otto Cycle



Four Stroke SI Engine– P-V Diagram

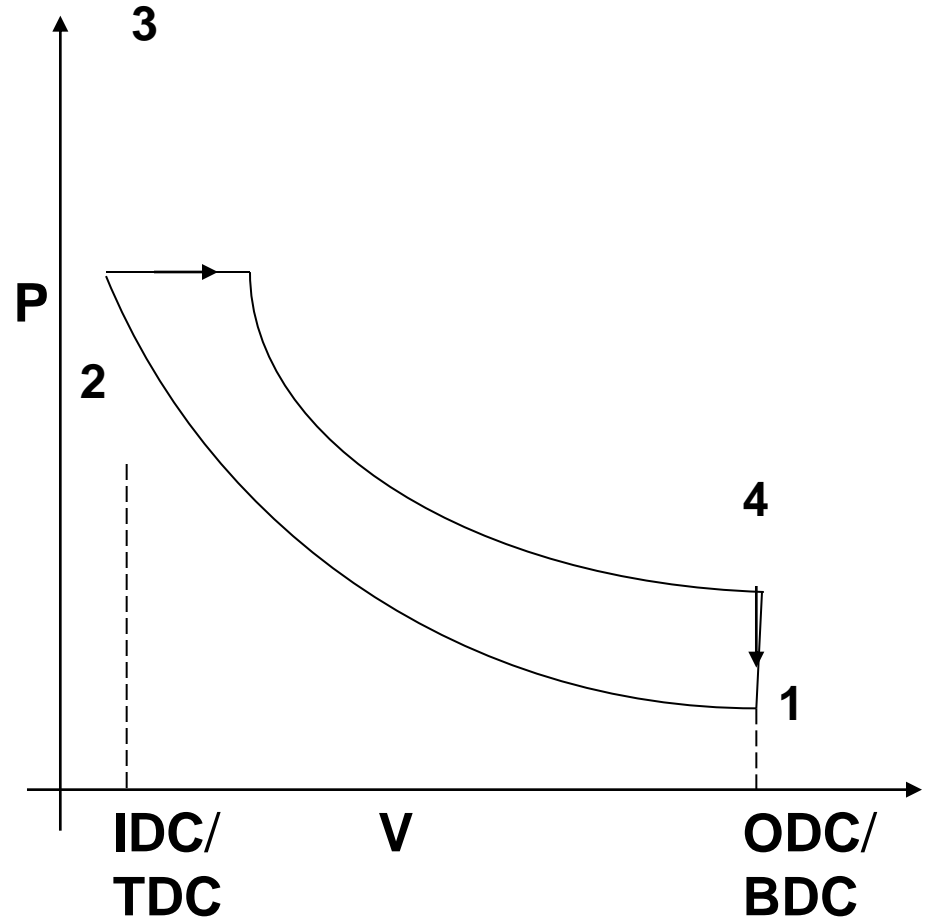
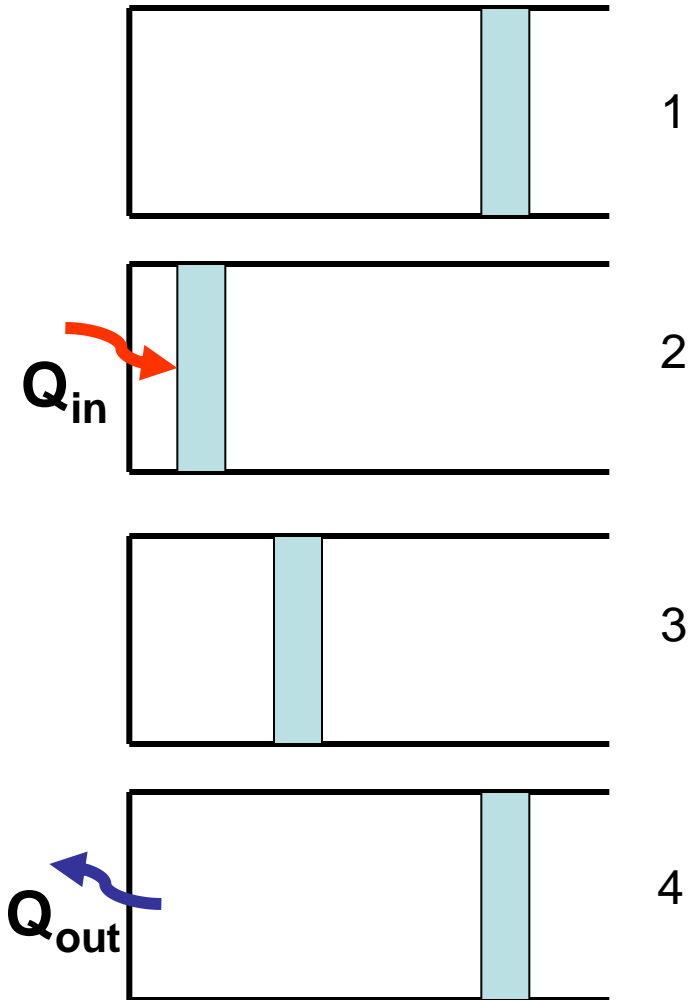


Four Stroke CI Engine

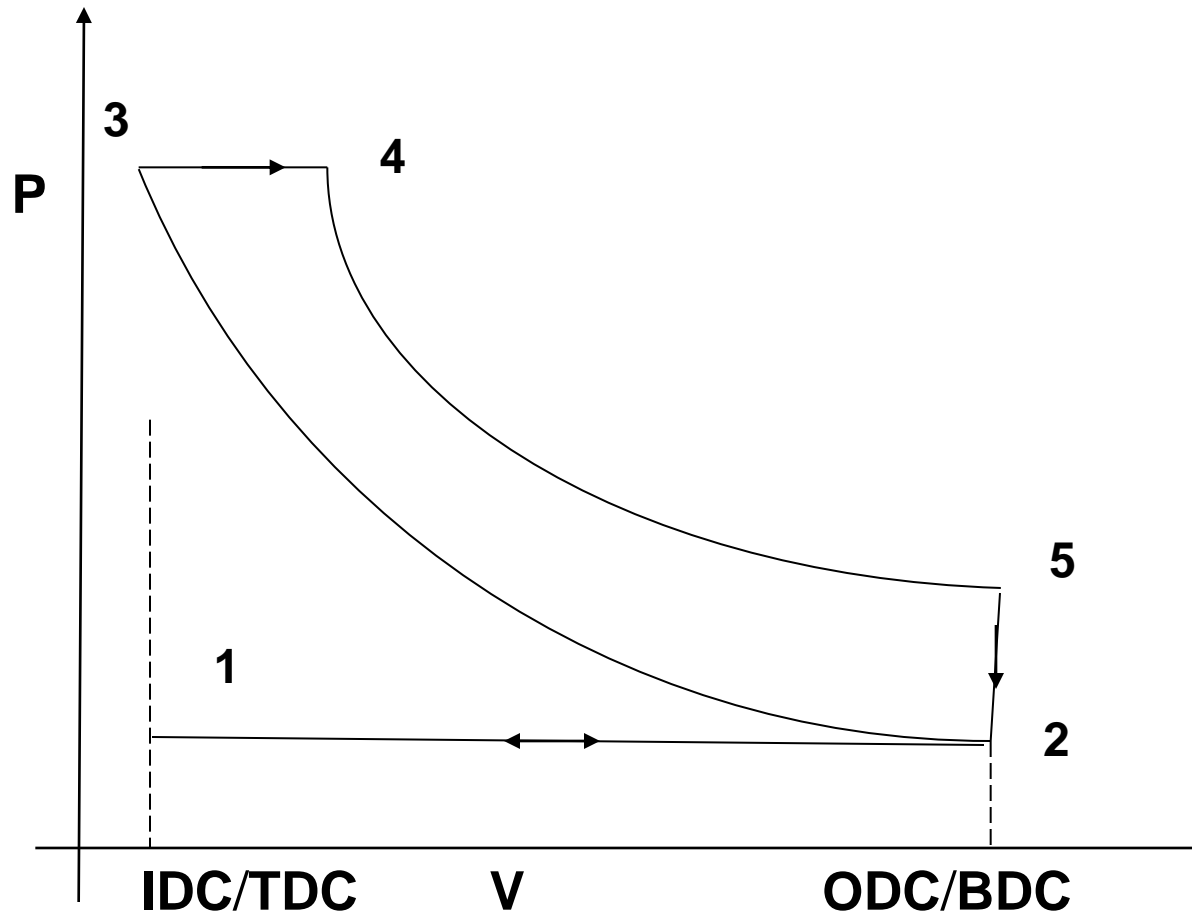


SV: Suction Valve; EV: Exhaust Valve

Diesel Cycle



Four Stroke CI Engine – P-V Diagram





Milestones of IC Engine - 1

An internal combustion engine is any engine that uses the explosive combustion of fuel to push a piston within a cylinder - the piston's movement turns a crankshaft that then turns a wheel via a chain or a drive shaft. The different types of fuel commonly used for car combustion engines are gasoline (or petrol), diesel, and kerosene.

1680 - Dutch physicist, Christian Huygens designed (but never built) an internal combustion engine that was to be fueled with gunpowder.

1807 - Francois Isaac de Rivaz of Switzerland invented an internal combustion engine that used a mixture of hydrogen and oxygen for fuel. Rivaz designed a car for his engine - the first internal combustion powered automobile. However, his was a very unsuccessful design.

1824 - English engineer, Samuel Brown adapted an old Newcomen steam engine to burn gas, and he used it to briefly power a vehicle up Shooter's Hill in London.



Milestones of IC Engine - 2

1858 - Belgian-born engineer, Jean Joseph Étienne Lenoir invented and patented (1860) a double-acting, electric spark-ignition internal combustion engine fueled by coal gas. In 1863, Lenoir attached an improved engine (using petroleum and a primitive carburetor) to a three-wheeled wagon that managed to complete an historic fifty-mile road trip. (See image at top)

1862 - Alphonse Beau de Rochas, a French civil engineer, patented but did not build a four-stroke engine.

1864 - Austrian engineer, Siegfried Marcus, built a one-cylinder engine with a crude carburetor, and attached his engine to a cart for a rocky 500-foot drive. Several years later, Marcus designed a vehicle that briefly ran at 10 mph that a few historians have considered as the forerunner of the modern automobile by being the world's first gasoline-powered.

1866 - German engineers, Eugen Langen and Nikolaus August Otto improved on Lenoir's and de Rochas' designs and invented a more efficient gas engine.

1873 - George Brayton, an American engineer, developed an unsuccessful two-stroke kerosene engine (it used two external pumping cylinders). However, it was considered the first safe and practical oil engine.



Milestones of IC Engine - 3

1876 - Nikolaus August Otto invented and later patented a successful four-stroke engine, known as the "Otto cycle".

1876 - The first successful two-stroke engine was invented by Sir Dougald Clerk.

1883 - French engineer, Edouard Delamare-Debouteville, built a single-cylinder four-stroke engine that ran on stove gas. It is not certain if he did indeed build a car, however, Delamare-Debouteville's designs were very advanced for the time - ahead of both Daimler and Benz in some ways at least on paper.

1885 - Gottlieb Daimler invented what is often recognized as the prototype of the modern gas engine - with a vertical cylinder, and with gasoline injected through a carburetor (patented in 1887). Daimler first built a two-wheeled vehicle the "Reitwagen" (Riding Carriage) with this engine and a year later built the world's first four-wheeled motor vehicle.

1886 - On January 29, Karl Benz received the first patent for a gas-fueled car.

1889 - Daimler built an improved four-stroke engine with mushroom-shaped valves and two V-slant cylinders.

1890 - Wilhelm Maybach built the first four-cylinder, four-stroke engine.

1892 – Rudolf Diesel invented Compression Ignition (CI) engine.

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Thank You